Priority based scheduling in Vehicular Ad-Hoc Network (VANET)

Submitted BY

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Priority based scheduling in Vehicular Ad-Hoc Network (VANET)

Major Project

Submitted in partial fulfillment of the requirements

For the degree of

Master of Technology in Computer Science and Engineering

Submitted By

Manish Singh

(12MCESCS2)

Guided By

Prof. Jitendra Bhatia

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Certificate

This is to certify that the Major Project entitled "Priority based scheduling in Vehicular Ad-Hoc Network (VANET)" submitted by Manish Singh (12MCECS2), towards the partial fulfillment of the requirements for the award of degree of Master of Technology in Computer Science and Engineering of Institute of Technology, Nirma University, Ahmedabad is the record of work carried out by him under my supervision and guidance. In my opinion, the submitted work has reached a level required for being accepted for examination. The results embodied in this major project, to the best of my knowledge, haven't been submitted to any other university or institution for award of any degree or diploma.

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Statement of Originality

I, Manish Singh, Reg.No. 12MCECS2 , give undertaking that the Major Project entitled "Priority based scheduling in Vehicular Ad-Hoc Network (VANET)" submitted by me, towards the partial fulfillment of the requirements for the degree of Master of Technology in Computer Science and Engineering of Nirma University, Ahmedabad, is the original work carried out by me and I give assurance that no attempt of plagiarism has been made. I understand that in the event of any similarity found subsequently with any published work or any dissertation work elsewhere; it will result in severe disciplinary action.

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Place: Institute of Technology, Nirma University

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Prof. Jitendra Bhatia

(Signature of Guide)

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With immense pleasure, I would like to present this report on the dissertation work related to "Priority based scheduling in Vehicular Ad-Hoc Network (VANET)".

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Abstract

A Vehicular Ad-hoc Networks are self-arranging networks created among vehicles outfitted with communication facilities. Because of late headways in vehicular advancements vehicular communication has risen. For a rich arrangement of uses executing intelligent highways, similar to application identified with street security, activity observing and administration, street debacle relief and so out and about side framework assumes a fundamental part for any VANET. This is the reason that effective communication between the vehicles and the street side framework is needed. Meeting this prerequisite gets to be exceptionally troublesome as nodes in a VANET are profoundly portable and along these lines the system topology is very dynamic.Primary objective of priority based scheduling scheme is to served by considering information type.The propose scheduling scheme to altogether decrease the overall packet reception delay, including the delay due to sensing for emergency messages in VANET. We determine the expression for normal packet reception delay for the proposed scheme and the reproduction results match with the explanatory results. The results demonstrate that the priority based scheduling scheme joined with our scheme significantly decreases the packet reception delay for the emergency messages and decreases the possibility to send to the false accident messages.

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Chapter 1

Motivation

1.1 Motivation

Vehicular Ad-hoc NETwork (VANET) is a subset of the Mobile Ad-hoc Network (MANET) which gives remote correspondence capacities between gadgets in a certain extent. VANET empower vehicles to impart among them (V2V) and with roadside base (V2I). VANET have been an exceptionally dynamic exploration subject in the most recent years because of the extremely positive effect of their usage in vehicular wellbeing, activity administration and data applications. Due to the vast span of VANET, number of messages to be handled by vehicle and Road Side Unit (RSU) are more. In this scenario which message should be processed first is the biggest issue. To handle this issue, different scheduling policies are implemented depending upon different scheduling parameters. The aim here is to study about different scheduling policies available in VANET and to improve service ratio in terms of packet delivery ratio with reduction in packet reception delay.

1.2 Thesis Outline

In Chapter 2 and 3, literature survey of related work and identified open issues are presented. Problem statement and proposed solution is elaborated in chapter 4, In

chapter 5 discussion of simulation result, In chapter 6 proposed solution,Discussion of simulation result is in Chapter 7. Finally chapter 8 contains conclusion and future work.

Chapter 2

Literature Survey

2.1 Introduction

2.1.1 Introduction to VANET

Introduction to VANET

A Vehicular Ad-Hoc Network, or VANET is an innovation that uses running vehicles as hubs in a system to make a portable system. VANET transforms each taking an interest vehicle into a remote switch or hub, permitting vehicles give or take 100 to 300 meters of one another to join and, thus, make a system with a wide range.

As vehicles drop out of the sign range and drop out of the system, different vehicles can join in, joining vehicles to each other so that a portable Internet is made.

VANET is a subgroup of MANET where the hubs allude to vehicles. Since the development of Vehicles are confined by streets, activity regulations we can send settled framework at discriminating areas.

The essential objective of VANET is to give street security measures where data about vehicle's present velocity, area directions are passed with or without the organization of Infrastructure.

Separated from security measures, VANET likewise gives worth included administrations like email, sound/feature offering and so forth.

2.1.2 Communication modes:

Different Communication modes in VANET:

(V to V) means Vehicle-to-Vehicle communication.

(V to I) Vehicle-to-Infrastructure, between vehicles (OBU) and Road-Side Units (RSUs).

(V to V and V to X) Vehicle-to-X, mixed V to V and V to I approach.

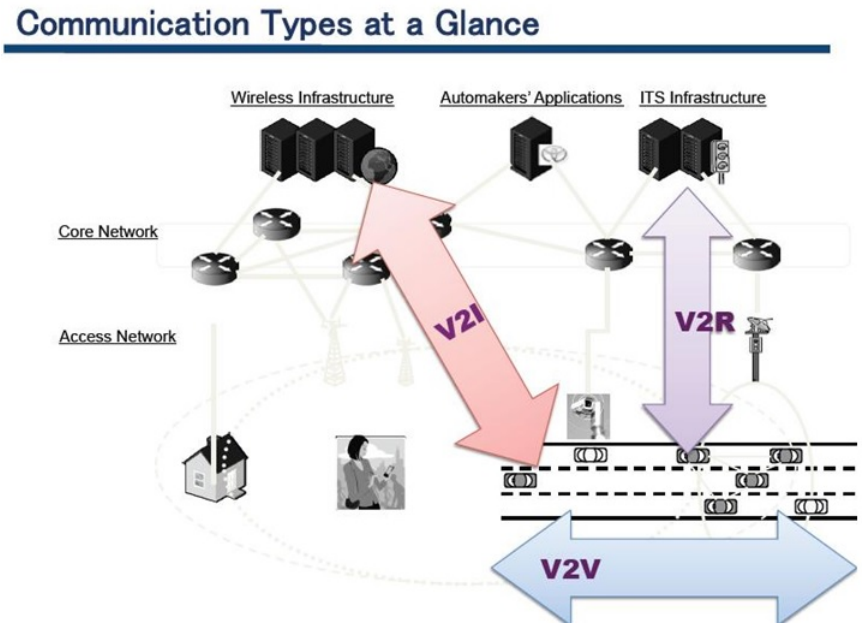

Figure 2.1: Communication modes[1]

2.1.3 VEHICLE TO VEHICLE COMMUNICATION (V2V)[2]

- Vehicle to Vehicle correspondence methodology is most suited for small range vehicular systems.
- It is Fast and Reliable and gives constant wellbeing.
- It needn't bother with any roadside unit.

2.1.4 VEHICLE TO INFRASTRUCTURE/ROADSIDE COMMUNICATION (V2I/V2R)[3]

- Vehicle to Infrastructure gives answer for more range vehicular systems.
- It makes utilization of prior system base, for example,[4] remote access focuses (Road-Side Units, RSU's).
- Interchanges in the middle of vehicles and RSU's are backed by Vehicle-to-Infrastructure (V2I) convention and Vehicle-to-Roadside (V2R) convention.

2.1.5 Different Applications for VANETs[5]

- Applications based on Public Safety.
- Applications based on Traffic Management.
- Applications based on Traffic Coordination and Assistance.
- Applications based on Traveler Information Support.
- Applications based on Comfort.
- Application based on Air pollution emission measurement and reduction.
- Enforcement of LAW.
- Broadband services.

2.1.6 Challenges in VANET[6]

- **Bandwidth Competition:** All requests compete for the same limited bandwidth.
- **Time Constraint:** Vehicles are moving and they only stay in the RSU range for a very short period of time [7]

2.1.7 Challenges in Scheduling in VANET[8]

- In most of the scheduling policies service deadline plays very vital role but in all, deadline is calculated depending upon the speed of the vehicle and the range of the RSU, What will be the deadline of the vehicle at traffic signal?
- Problem of starvation can be happen, No fairness

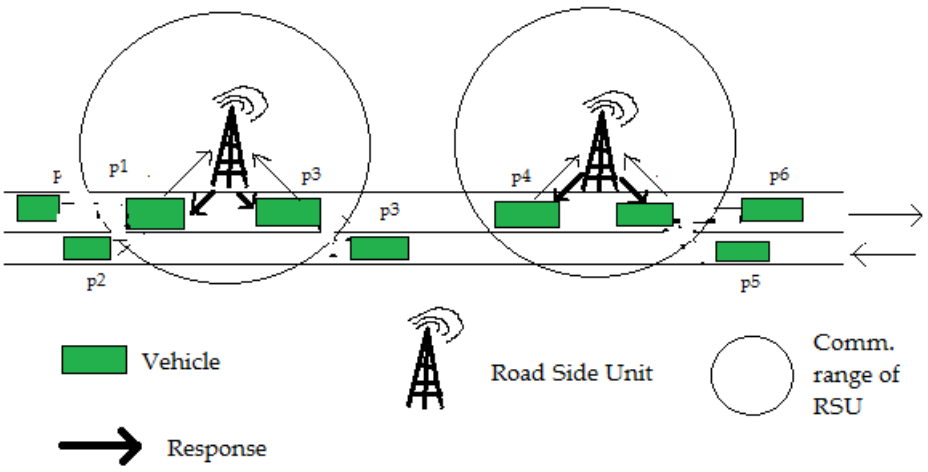

Figure 2.2: Communication Between RSU and OBU

2.1.8 Why Priority based scheduling?

- Large number of messages to be exchanged between either one vehicle and other vehicle or vehicle and infrastructure.
- In this scenario, many messages can be queued at RSU / OBU side.
- Problem : Which message should be broadcasted first?
- Solution :Priority based scheduling policies

Chapter 3

Various scheduling approaches

3.1 Comparison between various scheduling approaches I

Table I: Comparison between various scheduling approaches I

scheduling Approach	**Mechanism**	**Pros.**	**Issues.**
Motion prediction based cooperative scheduling scheme[9]	a motion prediction based booking plan which empowers helpful work among a set of Rsus for booking multi-thing solicitations. Information solicitations can be exchanged what's more in this way adjusted among Rsus.	• Workload of loaded RSUS is transferred to the different free RSUs, which serves to adjust RSU workload. • Both solicitation due date and information notoriety are joined when settling on booking choices to tackle the appeal starvation issue.	• The service ratio of the schemes decrease when vehicle (OBU) runes faster on the path. • When vehicle runes at fast speed, it will stay in the transmission range of a certain RSU for lesser time.
HyDiAck, a data dissemination protocol for VANETs[10]	Selects vehicles inside a forwarding zone to rebroadcast messages to further vehicles and protocol employs implicit Acks to guarantee robustness in message delivery	HyDiAck selects vehicles inside a forwarding zone to rebroadcast the message[11].HyDiAck embeds the IDs of the last messages received	It is difficult to work in traffic light crossing.

Table II: Comparison between various scheduling approaches II

Scheduling Approach	**Mechanism**	**Pros.**	**Issues.**
Routing Protocol with Reliability Enhancement (PRP-RE)[12]	PRP-RE can improving reliability as well as furthering communication range.	keeps rebroadcasting the packets and stops only when an ACK is get by the rsu or the rebroadcasting limit is reached.	• Realistic evaluation on more sophisticated mobility model and road topology, which include intersections[13]. • Improvements in security
FCFS FDF SDF [14]	First Come First Serve (FCFS),First Deadline First (FDF),Smallest Data Size First (SDF)	• In FCFS the packet who arrived first time will be served first. • In FDF the packet with the most urgent will get service first. • In SDF the data packet having small data size will be served first.	• FCFS does not take care of packet size and packet deadline. • FDF does not take care of packet size thus it ignore the service time. • SDF neglect the packet urgency[15].
D*S scheduling[8]	It is a sum of packet size and deadline scheme to improved scheduling performance is achieved	• When two packet data of two queues with having the same deadline, the one with small size packet should be get servic first. • When two packets of two queues with the same size, the one with earlier deadline should be served first.	For improving the broadcast service, the data with more pending requests should be considered first[16].

Chapter 4

Problem Definition

To develop a Priority based scheduling in VANET.

4.1 Assumptions

- A central processing unit (CPU) that implements the communication and applications protocols.
- A wireless transceiver that transmits and receives packets to from the neighboring vehicles and (RSU)roadside.

4.2 Objective

- To develop a Priority based scheduling strategy in VANET.

4.3 Intended Outcomes

- Develop priority based scheduling at RSU to improve service ratio by reduction in packet reception delay and decreases the possibility to send to the false accident messages.

Chapter 5

Simulation System

VANET Simulator software [17] are categorized into three main categories: Vehicular mobility generators, Network simulators, and VANET simulators.

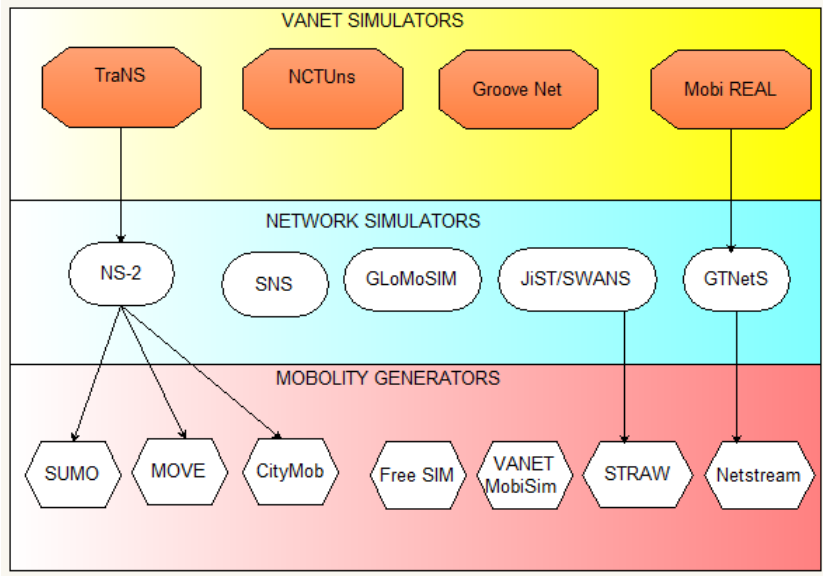

Figure 5.1: VANET Simulators

- Vehicular mobility generators are wanted to increase the level of practicality in VANET simulations[18]. Road model, scenario parameters are inputs of the mobility generator and the outcome of the model details the place of each vehicle at most of time instant for the compleat simulation time and their mobility

models. Examples are SUMO, MOVE and VanetMobiSim.

- Network simulators carry out exhaustive packet-level reproduction of cause, destinations, packet traffic transmission, reception, background load, route, links, and channels. Examples are ns-2, JiST/SWANS, and GloMoSim.

- VANET simulators supply in cooperation network simulation and traffic flow simulation. Examples are NCTUns, TraNS, and MobiREAL.

5.1 Mobility Generators for VANET

5.1.1 Simulation of Urban MObility

It [17] is an open source software. It is designed to handle large road networks. Its main features include different vehicle types, single-vehicle routing and dynamic routing, collision free vehicle movement , multi-lane streets, lane changing, hierarchy of junction types, an openGL graphical user interface (GUI).

Steps to generator mobility in SUMO:

a. Create a node.xml file.

b. Create a typ.xml file. Description of each edge and information about the number of lanes, the maximum speed allowed on this edge and priority. To avoid explicit defining of each parameter for every edge, one can use edgetypes, which encapsulate these parameters under a given name.

c. Create an edge.xml file that provides connection between different nodes.

d. Create a net.xml file using NETCONVERT command. For example netconvert –node-files=hello.nod.xml –edge-files=hello.edg.xml –type-files=hello.typ.xml –output-file=hello.net.xml

e. Create a rou.xml file that contains details of vehicles, vehicle types and routes.

f. Create sumocfg file that contains input files and simulation parameters.

g. Open sumocfg file in SUMO simulator and run it.

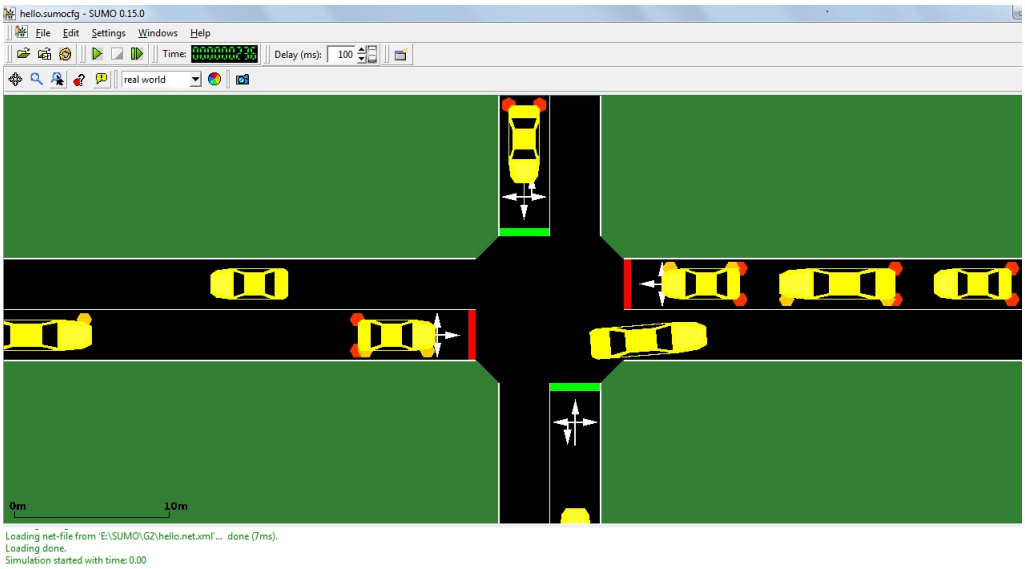

Figure 5.2: Mobility Generation using SUMO

Network Generation using NETGEN command: NETGEN used to implement three types of networks: grid-networks, spider-networks and random networks. Examples:

a. To generate Grid Network:

netgen –grid –grid.x-number=5 –grid.y-number=5 –grid.y-length=40 –grid.x-length=200 –output-file=GridSumo.net.xml

b. To generate Spider Network:

netgen –spider-net –spider-arm-number=10 –spider-circle-number=10 –spider-space-rad=100 –output-file=SpiderSumo.net.xml

c. To generate Random Network:

netgen –random-net -o RandomSumo.net.xml –rand-iterations=200 –abs-rand

5.1.2 MOVE (MObility model generator for Vehicular networks)

It rapidly generates realistic mobility models for VANET simulations [17]. MOVE is built on top of SUMO. The mobility trace file is the output of MOVE which can be used by network simulation tools immediately such as ns-2, GloMoSim, etc. In addition, MOVE provides a good GUI that allows user for quick scenarios generation without writing simulation scripts[19].

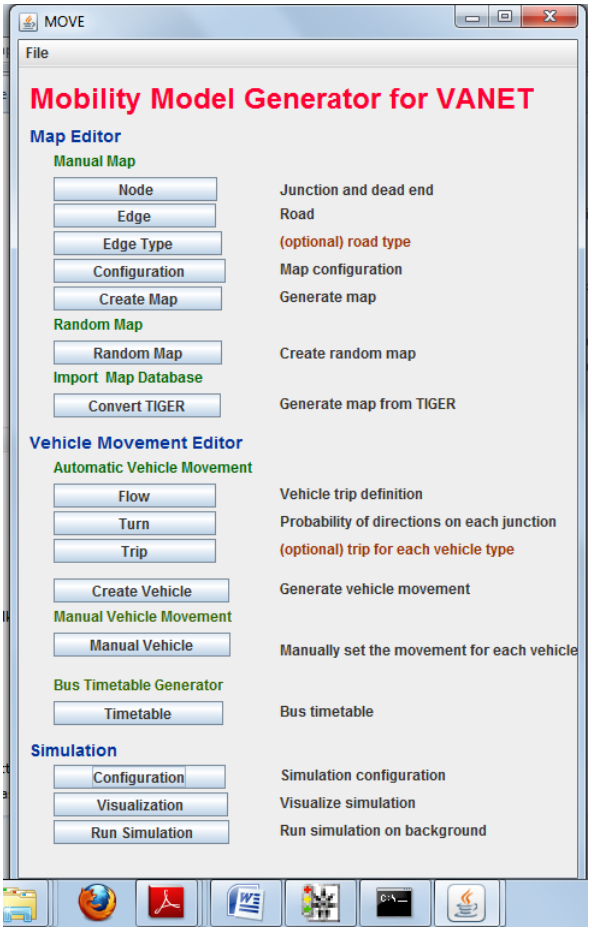

Figure 5.3: Mobility Generation using MOVE

Steps to generator mobility in MOVE:

a. Create a node.xml file using GUI.

b. Create a type.xml file using GUI.

c. Create an edge.xml file using GUI.

d. Create a net.xml file using Configuration option given in Create Map.

e. Create a rou.xml file that contains details of vehicles, vehicle types and routes.

f. Create sumo.cfg file that contains input files and simulation parameters.

g. Click on Visualization to run sumo.cfg file.

Steps to generator traffic model in MOVE:

a. Click on Traffic Model.

b. Click on Static Mobility.

c. Click in File then import MOVE Trace and .net.xml file for script generator.

d. Specify the file location for NAM and trace file.

e. Select File then Save or Save As (exNS.tcl).

f. Close Static Mobility window.

g. Then click on "Run NS-2".

h. Specify tcl script then click on Ok.

i. Close "Run NS-2".

j. To see visualization click on "Run Nam".

k. Specify NAM file then click on Ok.

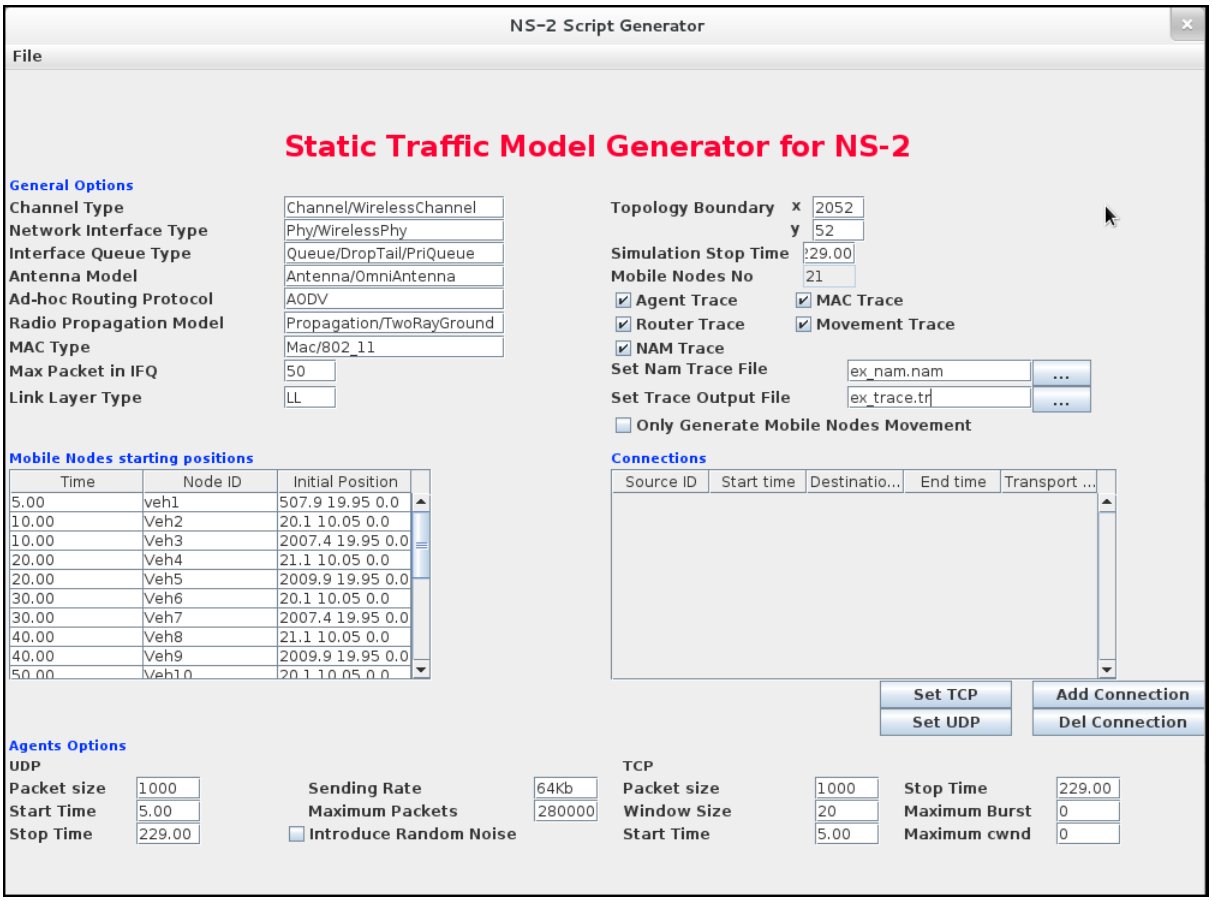

Figure 5.4: Traffic Model using MOVE

5.2 Network Simulators

5.2.1 NS-2

It is a simulator developed by the VINT project research group at the University of California at Berkeley [20]. The simulator was extended by the Monarch research group at Carnegie Mellon University to include: (a) node mobility, (b) a realistic physical layer with a radio propagation model, (c) radio network interfaces, and (d) the IEEE 802.11 Medium Access Control (MAC) protocol using the distributed coordination function (DCF).

Steps to install NS-2.34 in Fedora 17:

a. Download NS2.34.

b. Copy the file to /home/yourhome (in my case it is, /home/manish/).

c. Open terminal.

d. Untar it using tar zxvf ns-allione-2.34.tar.gz.

e. cd ns-allione-2.34/

f. ./install

g. During the installation there may be a error in linkstate/ls.h, the location of ls.h is /home/manish/ns-allinone-2.34/ns-2.34/linkstate/ls.h

h. Open the file: /home/manish/ns-allinone-2.34/ns-2.34/linkstate/ls.h

i. In line number 127, there will be a erase function, change it to this-¿erase and go to step 6.

j. Once installation over, set the PATH.

5.2.2 Create a new agent in NS2

we are created a new agent in ns2. Follow the following steps to create a new agent in ns2: **Steps to create a new agent in ns2:**

a. Create a MSRsuAgent.cc, MSRsuAgent.h, MSVehAgent.cc MSVehAgent.c files.

b. Put both files in NS2.34 folder.

c. Add MSRsuAgent and MSVehAgent object filename to the end of OBJECT CC list in Makefile.

d. Initialize packet size in ns-default.tcl.

e. Define the new packet type in packet.h.

f. Go NS2.34 folder.

g. Perform first make clean then make and make install.

h. Write MS.tcl file to test newly created agent.

Following figures show the output of the TCL and NAM file respectively.

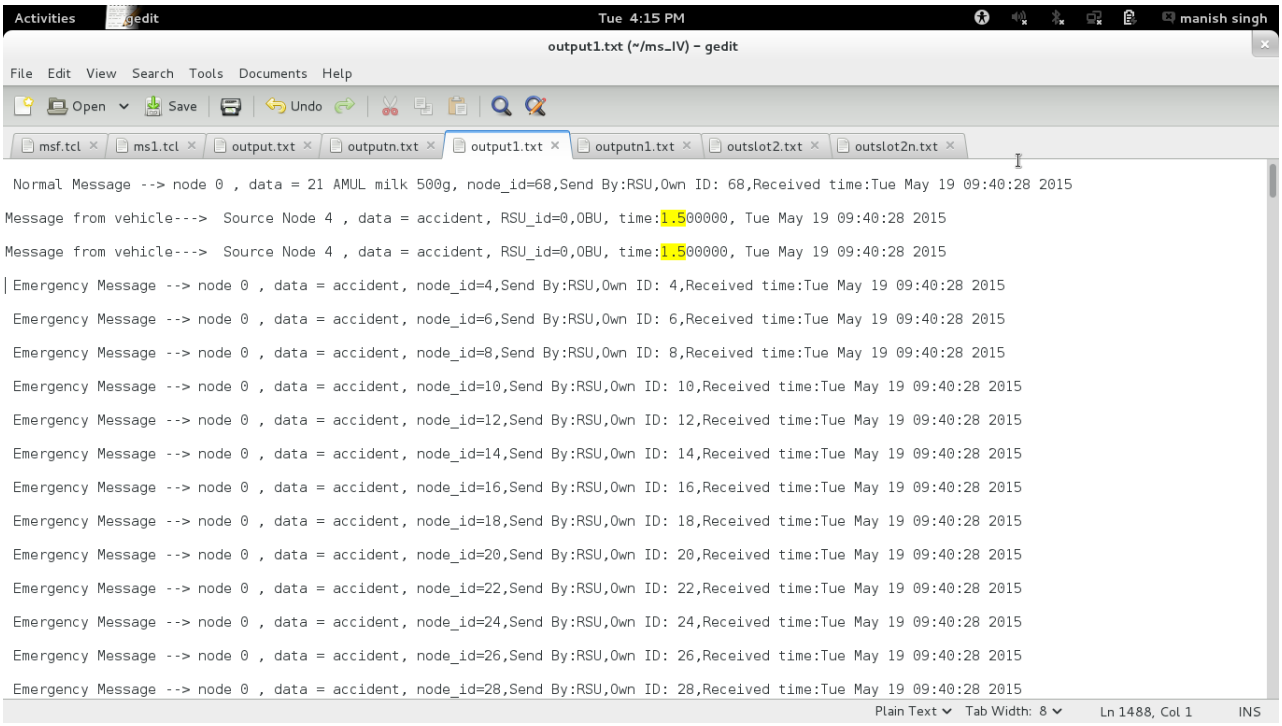

Figure 5.5: Output of TCL script with threshold value

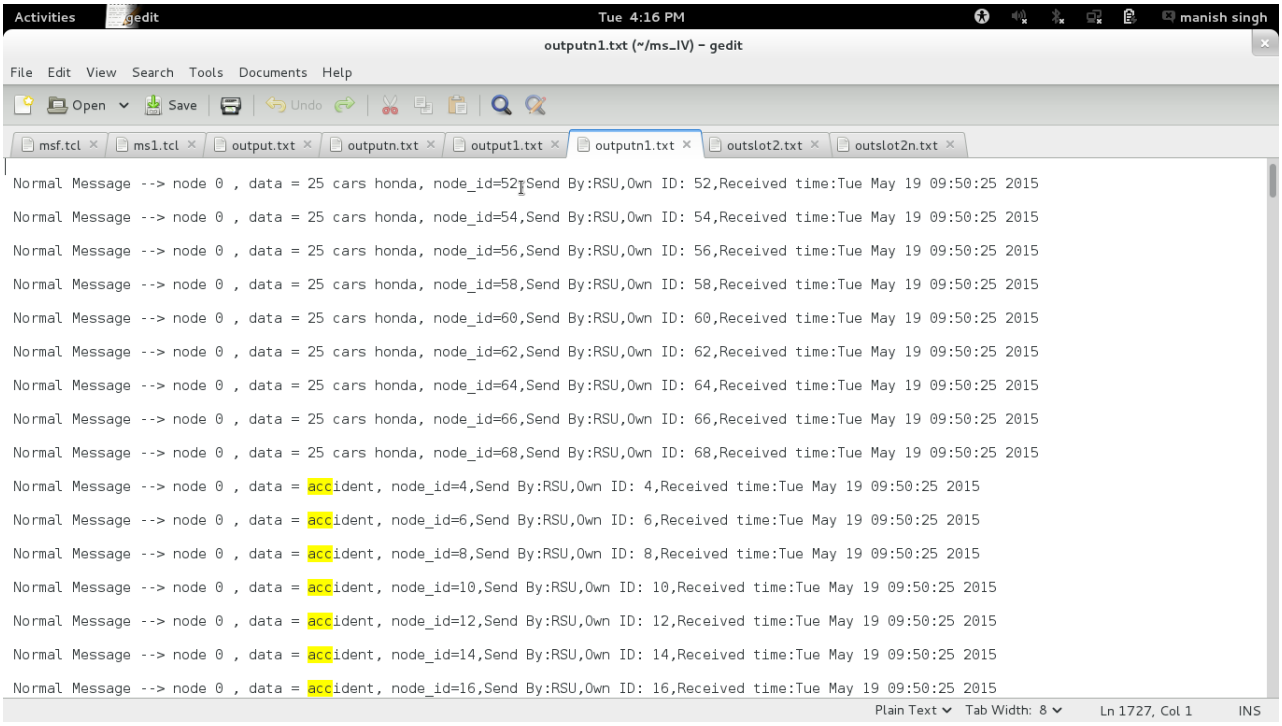

Figure 5.6: Output of TCL script without threshold value

Figure 5.7: NAM file Output

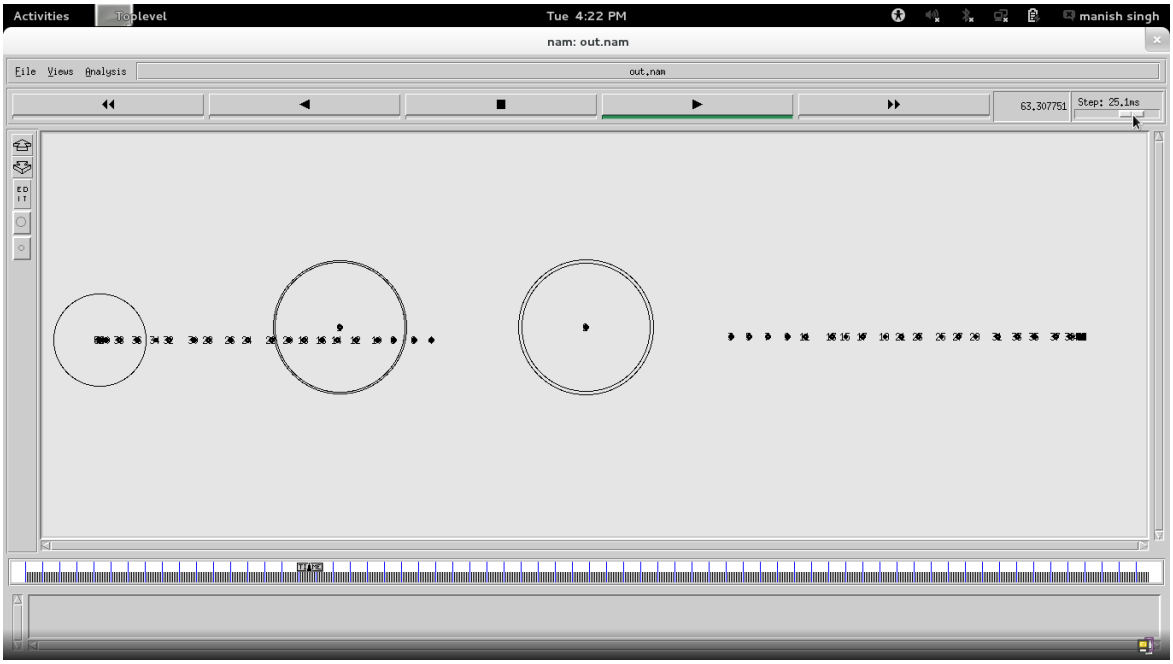

Figure 5.8: File Transfer Agent NAM file Output-1

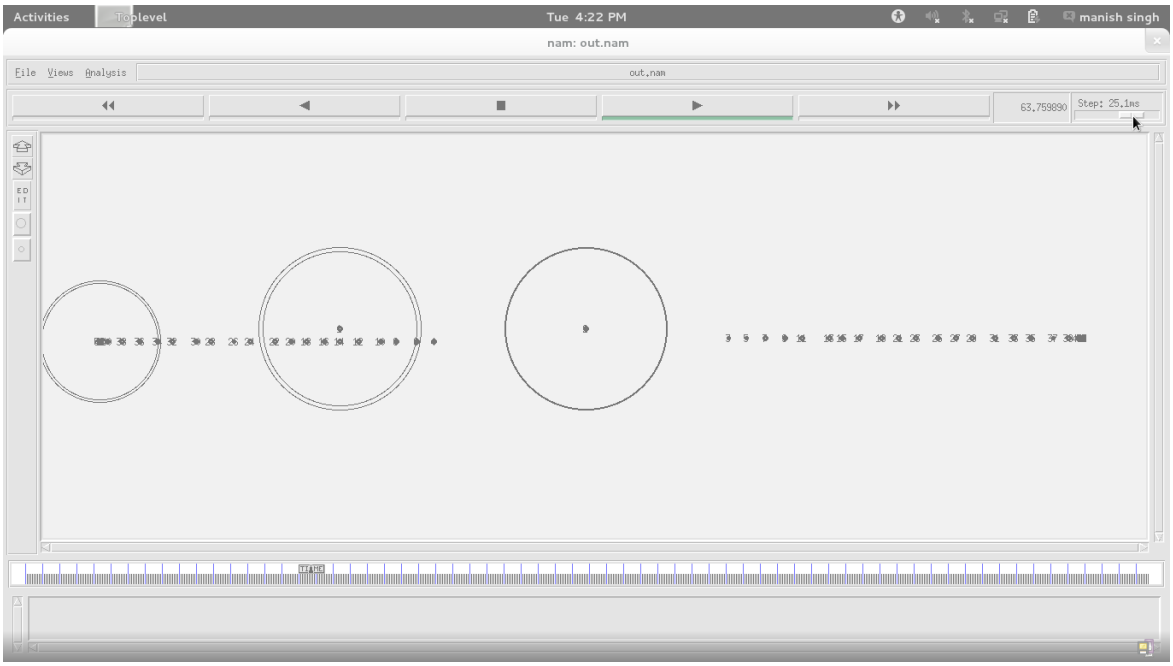

Figure 5.9: File Transfer Agent NAM file Output-2

Chapter 6

Proposed solution

6.1 Overview

Variables used in the approach are as under:
E-Queue = Emergency Queue
N-Queue = Normal Queue

- In our protocol, data transfer takes place whenever OBU nodes come into communication range of RSU.
- The algorithm below presents an overview of the prioritization. First the algorithm checks if there is a packet in the E-Queue buffer, and sends it . If there is no packet in this class, then the algorithm verifies the N-Queue buffers.
- If any accident is happened in any route then the vehicles can broadcast the emergency messages to the RSU. When the RSU received these messages from the vehicles it will store and wait for another same message from different vehicles and that should me match with the threshold value.
- If the threshold value meet with the required value it will put this message in the E-Queue and broadcast this message first.

- We put threshold value to prevent from false messages and we take this threshold value based on the peak hours of traffic.

6.2 Proposed approach

Proposed Algorithm:

Phase-1: RSU periodic messages broadcast

a. RSU periodically broadcast the Packets.

b. OBU receive Packets.

c. Data transfer takes place between RSU and OBU whenever both comes into communication range of each others.

Phase-2: Broadcast based on Priority

a. RSU maintain two different Queues for Different data type

b. EQ: For Emergency data (Safety related data)

c. NQ: For Normal data (Entertainment related data)

d. RSU will give highest priority to EQ messages.

e. First the algorithm checks if there is a packet in the E-Queue, and sends it.

f. If there is no packet in this class, then the algorithm verifies the N-Queue and sends the packets from N-Queue.

Phase-3: In case of Accident

a. In case of any accident OBU broadcast the emergency messages.

b. When the RSU received these messages from the OBU it will store and wait for another same message from different vehicles.

c. If the threshold value meet with the required values it will put this message in the E-Queue and broadcast this message first.

d. If the RSU did not get the minimum threshold value then RSU discards the messages.

RSU used following threshold value:

Sr NO:	**Time Period**	**Threshold Packets NO:**
1	7:00 AM to 11:59 AM	4
2	12:00 Clock to 17:59 PM	2
3	18:00 PM to 21:59 PM	4
1	22:00 PM to 7:00 AM	1

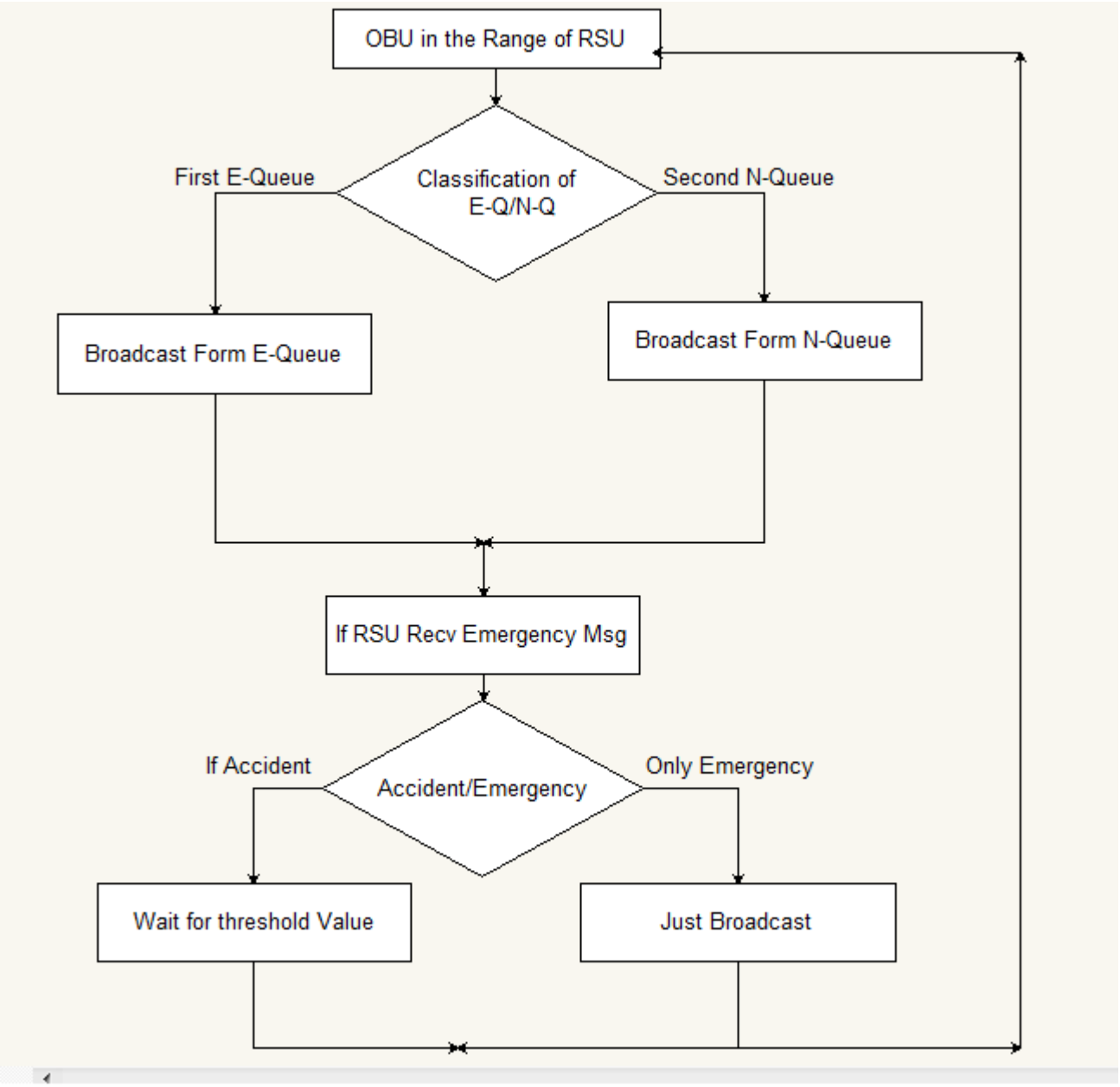

Figure 6.1: Flow Chart of Proposed Algorithm

Chapter 7

Results and Analysis

7.1 Simulation Parameters

All mobility scenarios are generated in MOVE work with SUMO, which is open source software. We had simulated proposed protocol in NS (Network Simulator) 2.34. Simulation parameters are mentioned in the following table.

Parameters	**Simulated Values**
Antenna model	Omni-directional Antenna
Radio Propogation Model	TwoRayGround
MAC Type	IEEE 802.11p
Interface Queue Type	Priority Queue
Simulation Time	1250 second
No. of vehicles	100
Speed of vehicles	13.79 m/s, 15 m/s, 25 m/s
Wireless range	250 m

7.2 Simulation Results

The network parameter of interest is to altogether decrease the overall packet reception delay. We determine the expression for normal packet reception delay for the proposed scheme and the reproduction results match well with the explanatory results. The numerical results demonstrate that the priority based scheduling joined with our scheme significantly decreases the packet reception delay for the emergency messages. We run the simulation for sufficient time.The protocol parameter is the broadcast emergency messages which specifies threshold value for given time slot after which RSU must broadcast the emergency message.

The threshold value for each time slot is different that is based on the traffic peak hours.In the conventional scheme the broadcast is based on the First Come First Serve bases and that is remain same throughout for all the broadcast.

Graph in Figure 7.1 represents effect of change in the packet reception delay. Emergency messages are broadcast by RSU with considering the accident messages with in the different time slot. In Figure 7.1 we observed that when RSU used priority

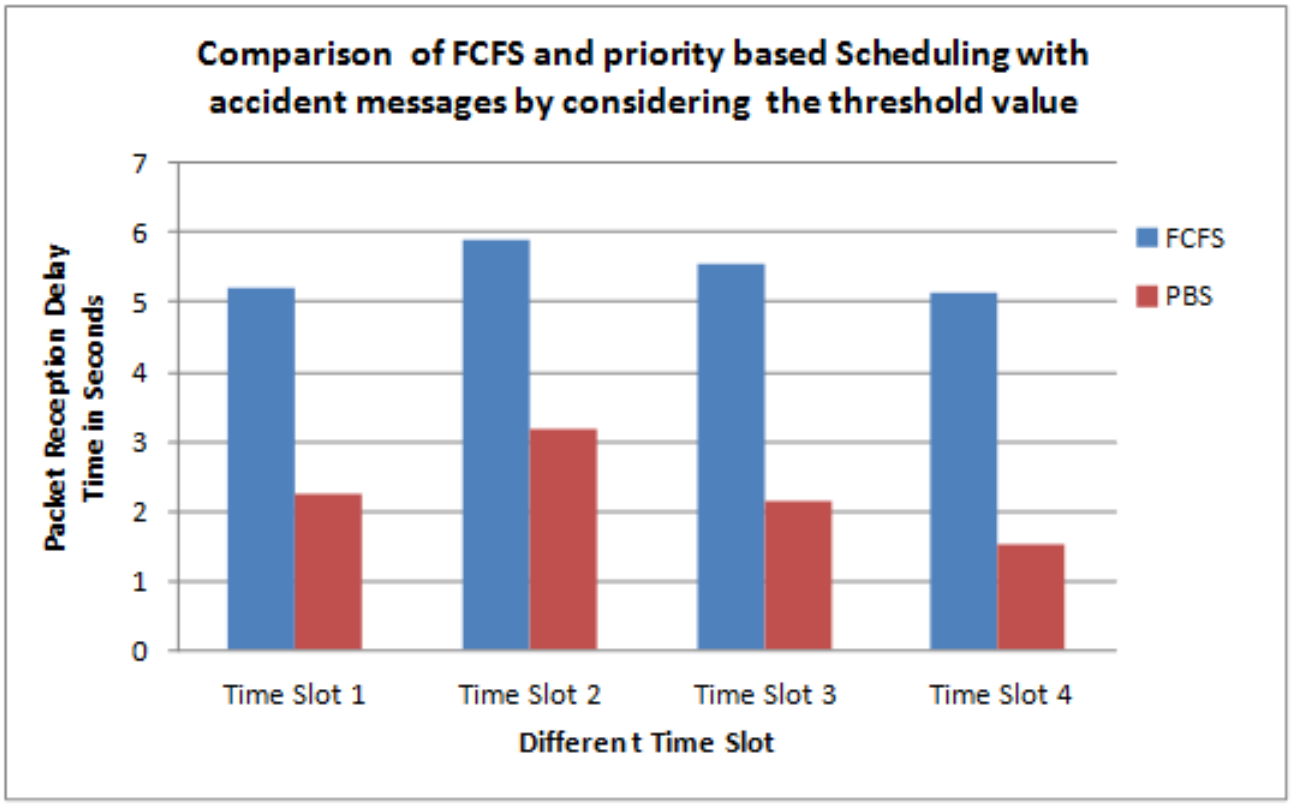

Figure 7.1: Packet Reception delay Vs Different Time Slot

based scheduling scheme for the broadcasting the accident messages with considering the different time slot the packet reception delay is decrease significantly as compare to conventional scheme.

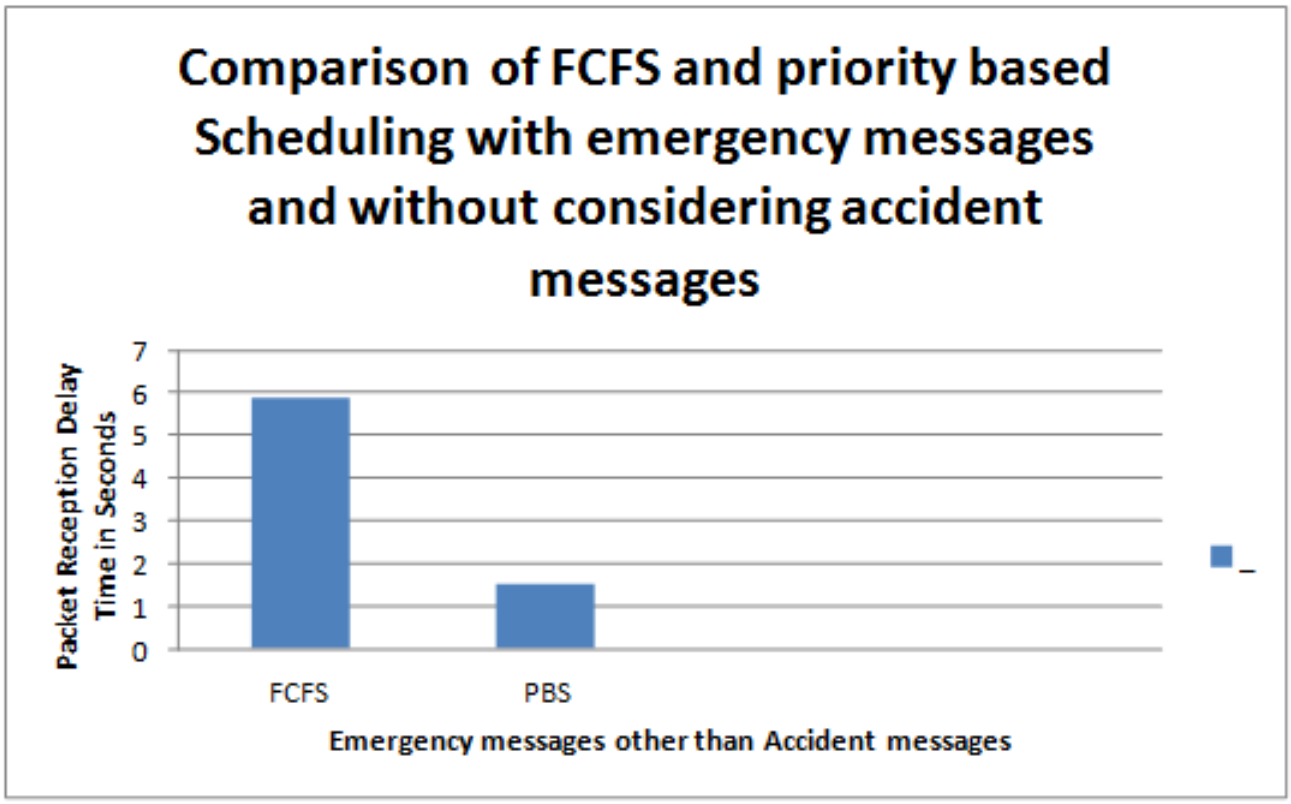

Figure 7.2: Packet Reception delay Vs Emergency messages other than accident messages

In Figure 7.2 we observed that when the RSU used priority based scheduling without considering the accident messages at that time priority based scheduling d'not wait for the threshold value of packet for ex. for time slot 1 threshold value is 4 so RSU should wait for at least 4 messages of accident but in non accident but emergency messages when RSU received message it just broadcast the messages.

Result shows the protocol using priority based scheduling gives better performance as compare to conventional protocol in terms of packet reception delay.

Chapter 8

Conclusion

Primary objective of priority based scheduling method is to give more priority to the emergency messages. The propose priority based scheduling scheme to altogether decrease the overall packet reception delay.
Major contributions of our work are as follows:

- Designed and implemented conventional and priority based broadcast protocol for emergency messages.

Summary of major findings of our work are as under:

- proposed scheme yields significantly reduction in packet reception delay of emergency messages without worsening the performance of normal messages.

8.1 Future Work

The protocol using priority based scheduling outperforms conventional scheme in terms of decreases the packet delay for the real time applications. Along with this, we will also incorporate priority based scheduling with traffic light for the batter management of traffic light and traffic.

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